

REMARKS/ARGUMENTS

Claims 1-46 and 73-81 are pending in this application. Nos. 14, 15, 19, 20, 39-42, 45, 46 and 76 are withdrawn by the Examiner from further consideration in this application as being directed to a non-elected invention. Nos. 1-13, 16-18, 21-38, 43, 44, 73-75 and 77-81 are presently under examination. These examined claims are, once again, rejected in accordance with 35 U.S.C. §103. Reconsideration of the claim rejections on the basis of the remarks presented herein is respectfully requested.

Rejection Under 35 U.S.C. §103

The Examiner continues to maintain the rejection under 35 U.S.C. §103 of claims 1-13, 16-18, 21-38, 43-44, 73-75 and 77-81 over Biella et al. (Journal of Catalysis) in view of USP 4,985,553 to Fuertes et al. and Biella et al. (Catalysis Today). The rejection is respectfully traversed.

The prior art references of Biella et al. (Journal of Catalysis), the Fuertes et al. '553 U.S. patent and Biella et al. (Catalysis Today) are all extensively analyzed in applicants' previous responses filed in this application and those remarks are expressly incorporated by reference into this discussion.

The main issue in this case, stated generally, is whether it would be obvious to one having an ordinary level of skill in the relevant art at the time the present invention was made, taking into account the disclosure contained within the cited combination of references, to substitute metal oxide supported catalysts for the carbon supported catalysts taught as being the most efficient by Biella et al. for the purpose of oxidizing sugars. Applicants respectfully reiterate their view that such substitution would, in fact, not be obvious, for the reasons previously set forth, and as discussed further below.

In applicants' response filed November 5, 2009 two sections of a text, *Fine Chemicals Through Heterogeneous Catalysis* edited by Sheldon et al. were cited and discussed as providing evidence that the prior art in the field of the present invention, at the time the presently claimed method was developed, evinced a strong prejudice against the use of metal oxide, rather than carbon, as a support for gold catalysts. Applicants thus consider the disclosure in the subject references to constitute "teachings away" from the substitution of metal oxide-based catalysts for carbon-based catalysts, which the Examiner has held would be an 'obvious' matter.

Applicants interpret the Examiner's argument to be that the disclosure contained in the Sheldon et al. references, i.e., that carbon supports are stable at low pH, does not constitute a teaching away from the substitution of metal oxide supports for carbon supports due to the fact that it is also known from Biella and Fuentres et al. to use catalysts having metal oxide supports at high pH. In response, however, applicants note that Sheldon et al. discusses in §9.2 the "general knowledge" of one of at least ordinary skill in this art with respect to the oxidation of alcohols and aldehydes on metal-based catalysts, as well as discussing the oxidation of carbohydrates on metal-based catalysts in §9.3. Page 496 of the reference indicates that carbon-based catalysts are believed to exhibit high stability in all reaction conditions, particularly at low pH and in the presence of complexing molecules.

Of particular relevance to one of at least ordinary skill in this art in the technical 'context' of applicants' claimed method is the fact that sugars and other carbohydrates are known to be substrates having excellent complexing and chelating properties due to the presence of several functional groups thereon, i.e., especially hydroxyl groups. For instance, Sheldon indicates on p. 509, second paragraph, that gluconic acid is a biodegradable chelating agent with excellent complexing properties. This background knowledge of one with ordinary skill at the time the presently claimed invention was made is confirmed by the disclosure contained in Venema et al., "Platinum-catalyzed Oxidation of Aldopentoses to Aldaric Acids", Journal of Molecular Catalysis, 77 (1992) 75-85 (previously made of record in this application), which states at p. 78 that aldopentoses have distinctive metal-ion-chelating properties. As further taught by the reference, strong complexation may result in blocking (product-inhibition) or leaching of active catalyst sites, for example, of the Pt^{n+} type. One of at least ordinary skill in the relevant art thus would learn from Sheldon et al. and Venema et al. that the oxidation of glucose and other carbohydrates is, in any case, carried out under strong complexing conditions. Thus, to applicants as ones having at least an ordinary level of skill in the relevant art, the disclosure of the subject references clearly teaches away from the use of metal oxide-based catalysts in favor of the use of catalysts relying instead on carbon supports.

Thus, for the reasons above applicants respectfully traverse the Examiner's view (Office Action p. 5, last three lines) that the teaching of Sheldon et al. is related to the oxidation of glyoxal, but not of carbohydrates. As indicated above carbon supports are taught by the reference to be preferable over metal oxide supports for all oxidation reactions involving alcohols and

aldehydes. This is further indicated by the disclosure contained at p. 516, lines 1-2 and this is so particularly with regard to the use of metal-based catalysts in the oxidation of carbohydrates. Irrespective of whatever disclosure Sheldon et al. contains regarding glyoxal, the teachings of the subject reference are also particularly relevant to reactions involving the oxidation of carbohydrates.

Turning, then, to a discussion of the disclosure contained in the Fuertes et al. '533 patent applicants submit that the subject patent is directed to a process for the selective oxidation of di-, tri-, oligo- and polysaccharides comprising reducing a terminal function of the aldose-type into polyhydroxycarboxylic acids. Noble metal based catalysts, wherein the metal is selected from palladium, platinum, rhodium and osmium, are used for the indicated purpose. The teaching of the reference generally suggests carbon as the appropriate support. In only one paragraph (see, e.g., col. 2 lines 40-45) does the reference mention that it may also be possible to utilize metal oxide supports, such as alumina and titanium oxide.

In the experiments described in Fuertes the oxidation of various different sugars and/or sugar derivatives are carried out in the presence of noble metal catalysts on carbon supports. There is no data provided in the reference relating to the use of catalysts having metal oxide supports. Fuertes, therefore, does not provide any proof that metal oxide supported catalysts may be used under reaction conditions comparable to those used with carbon supports while obtaining equivalent results.

In any case, metal oxide based oxidation catalysts, in general, are of course known in the art. Fuertes et al. does note, moreover, that these catalysts may be used in the oxidation of carbohydrates. However, the reference does not teach metal oxide supported catalysts in general being favored due, for example, to having better properties or higher stability. Fuertes et al. also does not teach or suggests the use of the metal-based catalysts as recited in the present claims. One of ordinary skill in the art, therefore, would not find themselves motivated by the disclosure of Fuertes et al. to use a metal oxide support for the particular gold catalyst taught and claimed in the present application in view of the knowledge obtained from the prior art (such as Sheldon et al. and Venema et al.) which, for the reasons presented above, leads one away from using metal oxide supported catalysts and toward the use of catalysts on a carbon support.

Turning next to a discussion of the Biella et al. (Journal of Catalysis) reference, applicants submit that the Examiner appears to be of the opinion that fig. 3c of Biella et al.

demonstrates that at a controlled pH of 9.5, the catalyst is more active. The Examiner, furthermore, takes the position that it is not clear from the results applicants have provided whether applicants' results are significantly better than those set forth in Biella et al., which are based on Au/C catalysts at a controlled pH.

It is readily determinable from figure 3c of Biella et al. that 100% conversion in the oxidation of glucose is reached after about 30 minutes during the first run and after a considerably longer time during subsequent runs, e.g., after about 85 minutes during the fourth run. The same degree of conversion is reached during the last run at a time three times longer than in the first run. The activity of a catalyst is defined in terms of conversion per time obtained with the use of the subject catalyst. Therefore, figure 3c offers a clear and unambiguous showing that the activity of the catalysts as disclosed in Biella et al. does decrease during consecutive runs.

Moreover, figure 3c additionally demonstrates that the initial conversion rate, i.e., at the beginning of the reaction, also decreases considerably in consecutive runs. The curve of the first run shows an initial conversion of 10% while the curves for runs 2-4 show an initial conversion of about 5%.

In contrast to what is shown in figure 3c, the catalysts used according to the presently claimed method show a constant level of activity over at least 10 batches (runs) – see, for instance, Example 3 of the present application and the declaration of Dr. Haji Begli dated June 23, 2009 provided as an attachment to the Response to Final Office Action filed on June 25, 2009. The catalysts used according to the presently claimed method thus demonstrate a significantly higher durability when compared to the catalysts disclosed in the cited prior art.

Further to the above, on p. 6 of the Office Action the Examiner interprets the reaction in applicants' Example No. 3 as being, "run throughout the day, overnight or over the weekend". The Examiner then, based on this interpretation, concludes that longer reaction times would always result in a higher conversion or yield. Applicants respectfully submit, however, that the Examiner's interpretation appears to them to lack any basis in the application as filed. That is, according to Example 3 of the application, the long term stability of the exemplified 0.5% Au/TiO₂ catalyst was assessed with the use of a standard procedure, i.e., repeated batch tests. Oxidation of glucose was carried out until the glucose was fully converted into gluconic acid (100% conversion). Afterward, the catalyst was left standing in the reaction solution to enable

the catalyst to settle. This is also a common procedure. Additionally, following the conversion the addition of base was terminated. The settling of the gold catalysts and the termination of base addition, in fact, actually serve to prevent the gold catalyst from oxidizing glucose, "overnight or over the weekend". Moreover, in any case since the conversion was complete (100%) there was in fact no educt (i.e., glucose) left to be oxidized following the run.

As stated above catalyst activity is defined by the amount of conversion over time. Thus it is evident from Table 6 of the present application (see p. 47) by its showing an initial activity of the catalyst to be at least 320 mmol_{glucose}/g_{metal} demonstrates that the oxidation of the glucose is carried out much faster than has been assumed by the Examiner.

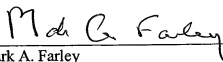
Summary

Applicants respectfully submit that the points set forth above, when coupled with the data provided in the application, effectively serve to demonstrate that the presently claimed method would not be suggested to one having at least an ordinary level of skill in this art over the combined disclosure of the references cited in the Office Action to reject applicants' claims.

The Examiner is, therefore, respectfully requested to reconsider and withdraw the rejection of applicants' claims and to issue a Notice of Allowance for all of the claims presently under examination in the application.

THIS CORRESPONDENCE IS BEING
SUBMITTED ELECTRONICALLY
THROUGH THE PATENT AND
TRADEMARK OFFICE EFS FILING
SYSTEM ON March 10, 2010.

Respectfully submitted,



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